

SEMS DocID

2261571

ORIGINAL
(Red)

**EXPERT REPORT
ON THE
HISTORICAL AERIAL PHOTOGRAPHIC AND CARTOGRAPHIC
ANALYSIS
OF THE
SHAFFER EQUIPMENT SITE, MINDEN, WEST VIRGINIA**

prepared for

U.S. Department of Justice
Environmental Enforcement Section
Washington, D.C.

by

E. Terrence Slonecker
Environmental Scientist
U.S. Environmental Protection Agency
Environmental Photographic Interpretation Center
166 Bicher Road, Vint Hill Farms Station
Warrenton, Virginia 22186

(703) 341-7511

05 June 1992

~~(703) 349-8970~~
349-8970 PAT
(703) 341-7500

INTRODUCTION

This report presents an analysis of the Shaffer Equipment Site, in Minden, West Virginia, as derived from historical aerial photography and existing map products. This analysis was performed at the request of the United States Department of Justice (DOJ) in order to assist in the assessment of past operating practices which may have contributed to soil contamination at the site.

This report was prepared by E. Terrence Slonecker, Environmental Scientist, United States Environmental Protection Agency. The author holds a B.S. in Governmental Administration from Christopher Newport College and a M.S. in Geographic and Cartographic Sciences from George Mason University. Additionally, the author is a 'Certified Photogrammetrist', as recognized by the American Society of Photogrammetry and Remote Sensing. Attached documents include the author's SF-171 and EPA position description.

SCOPE OF WORK

At the request of DOJ, the author was requested to analyze photographic and cartographic evidence to address the following:

1. The historical pattern of on-site activities at the Shaffer Equipment site that could have contributed to soil contamination in the area.
2. The location of property lines adjoining the Shaffer site with respect to on-site activities.
3. Whether or not the Shaffer site is located on a flood plain.
4. The general slope of the site area.

METHODOLOGY

Photogrammetry is defined as the "...art, science and technology of obtaining reliable information about physical objects and the environment through processes of recording, measuring, and interpreting photographic images and patterns of recorded radiant electromagnetic energy and other phenomena" (Wolf, 1983, page 1). Photogrammetry is generally divided into two broad sub-classes, *photo interpretation* and *metric photogrammetry*.

Photo interpretation involves "...the act of examining photographic images for the purpose of identifying objects and judging their significance" (Wolf, 1983, page 514). Aerial photographs represent a detailed record of conditions and activities on the ground at the time of exposure. A photo interpreter systematically studies aerial photographs and examines fundamental characteristics of size, shape, pattern, shadow, tone, texture and location of photographic images in order to identify them and determine their relative significance.

Metric Photogrammetry is the science of obtaining reliable measurements from photographs for the purposes of mapping and as a general aid to the identification of various objects. Metric photogrammetry involves the creation

of complex visual and mathematical models that correct for inherent distortions in aerial photographs. From these models a wide variety of measurements activities can be accomplished such as measuring the length, width and depth of any object or part of the ground surface of the aerial photograph. Metric photogrammetry is the fundamental science behind modern map-making. Nearly all medium and small scale maps are created from photogrammetric techniques.

Central to both photo interpretation and metric photogrammetry is the concept of three-dimensional stereoscopic viewing. Aerial photography is generally flown so that each successive frame overlaps the preceding frame by approximately 60%. This creates a situation where every object on the ground surface is imaged on a least two different photographs taken from slightly different angles. By converging these images together through a optical viewing device, called a stereoscope, the analyst is able to see the ground surface in three-dimensions. This is a great aid to the interpretative process as well as a fundamental technique for measurement.

A search of government and commercial sources of aerial photography was conducted in order to determine the best available aerial photography of the site over its operational period. Aerial photography of the Shaffer Equipment site was acquired for a time frame spanning 1957 to 1983. Details of the aerial photographs and maps used in the preparation of this report are listed in the References Section.

Photographic interpretation was performed by viewing backlit transparencies of aerial photographs through a stereoscope. A stereoscope is an optical device that allows two aerial photographs of the same area, taken at slightly different angles, to be focussed together, creating a three dimensional stereo model. Stereoscopic viewing, combined with viewing at various magnifications, allows the photo analyst to identify signatures of environmentally significant activity. The term 'signature' refers to a combination of visible characteristics (such as color, tone, shadow, texture, size, shape, location, and association) which permit a specific object or activity to be recognized on aerial photography.

Photogrammetric measurements were accomplished on a device called an analytical stereoplotter (ASP), which is a precisely calibrated, computer-driven instrument designed to create visual and mathematical models from pairs of aerial photographs for the purpose of measurement and the creation of cartographic products.

RESULTS

1. General Site Activities.

The photo interpretation of the Shaffer Equipment site from historical aerial photographs indicates a general pattern of open storage of equipment, cylindrical objects, possible stains, impounded liquid, mounded material, and other unidentifiable objects along the access road to the west of the site extending as far as 500 feet from the main building. See Figures 1, 2 and 3. This activity was noted on aerial photographs from 1973 through 1983.

Figure 1 is an enlargement from a 1975 aerial photograph showing this general pattern of open storage. In addition to the general pattern of open

storage, visible are possible stains, cylindrical objects (possibly drums and/or transformers), and mounded material.

Figure 2 is an enlargement from a 1980 aerial photograph again showing the general pattern of open storage along either side of the access road to the west of the main building. Visible here are areas of debris, possible stains, impounded liquid and two small pits.

Figure 3 is an enlargement from a 1981 aerial photograph showing a similar pattern of open storage activity.

2. Property Lines.

DOJ supplied the author with a property map of the Shaffer Equipment and surrounding properties (Fayette Engineering, 1991). This property map was optically overlain on to a March 31, 1981, aerial photograph using a device called a zoom transfer scope (ZTS). A ZTS is an optical-mechanical device that enables the operator to superimpose the image of a map or photo onto another map or photo for purposes of mapping or analysis. It allows the operator to align known features and correct for image or map errors through image rotation, stretching and magnification. The property lines from this map are shown as an overlay on Figure 3. The area of open storage at the Shaffer Equipment site clearly extends 200-300 feet beyond the Shaffer property onto the property of the Berwind Land company. Assuming that the property lines did not change and that they are depicted accurately on the Fayette Engineering map, this condition was consistent throughout the 1973-1983 time frame.

3. The Location of the Shaffer Site with respect to the Flood Plain.

On June 3, 1992, I received, from the Federal Emergency Management Agency (FEMA), a series of Flood Insurance Rate Maps (FIRM) for Fayette County, West Virginia. These maps are produced by the FEMA for use in administering the National Flood Insurance Program. FIRM maps show areas of potential 100-year and 500-year flood damage that are computed from cross sections and hydraulic considerations with regard to the requirements of the Federal Emergency Management Agency (FEMA, 1988).

FIRM Map number 540026 0175 B, dated March 4, 1988, covers the area of Oak Hill and Minden, West Virginia. This map shows the entire area of the Shaffer Equipment Site to be located in a zone designated "SPECIAL FLOOD HAZARD AREAS INUNDATED BY 100 YEAR FLOOD". Figure 4 is a xerox enlargement of this map showing the location of Arbuckle Creek, the Shaffer Equipment Site, and the C&O Railway. The Shaffer site is generally bounded by Arbuckle Creek to the north and the Railroad Right-of-Way to the South. Additionally, both of these features are within the shaded floodway area of this map. It is clear from this map that the Shaffer Equipment Site is entirely located within a 100-year flood plain.

4. The General Slope of the Shaffer Site.

To address the issue of slope at the Shaffer site, a stereo model was created from the 1975 aerial photographs, on a Kern DSR 15 analytical stereoplotter. Control was established from the Fayette Engineering map and the USGS topographic quadrangle maps of the area. The stereo model was corrected for all major photogrammetric orientations. The residuals from the absolute orientation show

ORIGINAL
(Red)

a 5 foot standard deviation in the planimetric accuracy and a 6 foot standard deviation in the vertical accuracy. Point elevations were read along three linear transects in the west area of the site. These elevations are shown as an overlay to Figure 1. These elevation values clearly show that the general open storage area slopes in a northeast to southwest direction, generally sloping down the access road toward the main Shaffer Equipment building.



REFERENCES

AERIAL PHOTOGRAPHY

Date	Agency	Code	Frame #	Scale	Frame #
May 8, 1957	ASCS ¹	DZC	7R:51-53	1:20,000	34954-56
October 18, 1969	ASCS	DZC	2KK:20-22	1:20,000	34659-61
November 15, 1973	PI ²	OAK HILL	42-43	1:12,000	39039-40
August 12, 1975	PI		33-35	1:6,000	39043-44
April 3, 1980	PI		38-39	1:6,000	39037-38
March 31, 1981	ASI ³	CFL	1:01,02	1:6,000	34957-58
November 13, 1981	ASCS	54019	179:120-22	1:40,000	34662-64
April 22, 1983	PI	4	1000,1001	1:24,000	39041-42

¹Agricultural Stabilization and Conservation Service, U.S. Department of Agriculture

²Pentree Incorporated

³Air Surveys, Inc., Sterling, VA

⁴U.S. Geological Survey, U.S. Department of the Interior

ORIGINAL
(Red)

MAPS

Source	Name	Scale	Date
USGS ⁴	Oak Hill, WV	1:24,000	1989
USGS	Thurmond, WV	1:24,000	1988
Fayette Engineering	Map Showing Resurvey of Berwind Land Company Property Adjoining the Tracts of E. William Shaffer and Leroy C. Britt at Minden, Fayette County, West Virginia	1:360	June, 1991
FEMA	Flood Insurance Rate Map (FIRM) Fayette County, West Virginia, Unincorporated Areas, Panel 175 of 275. Community-Panel Number 540026 0175 B	1:24,000	March 4, 1988

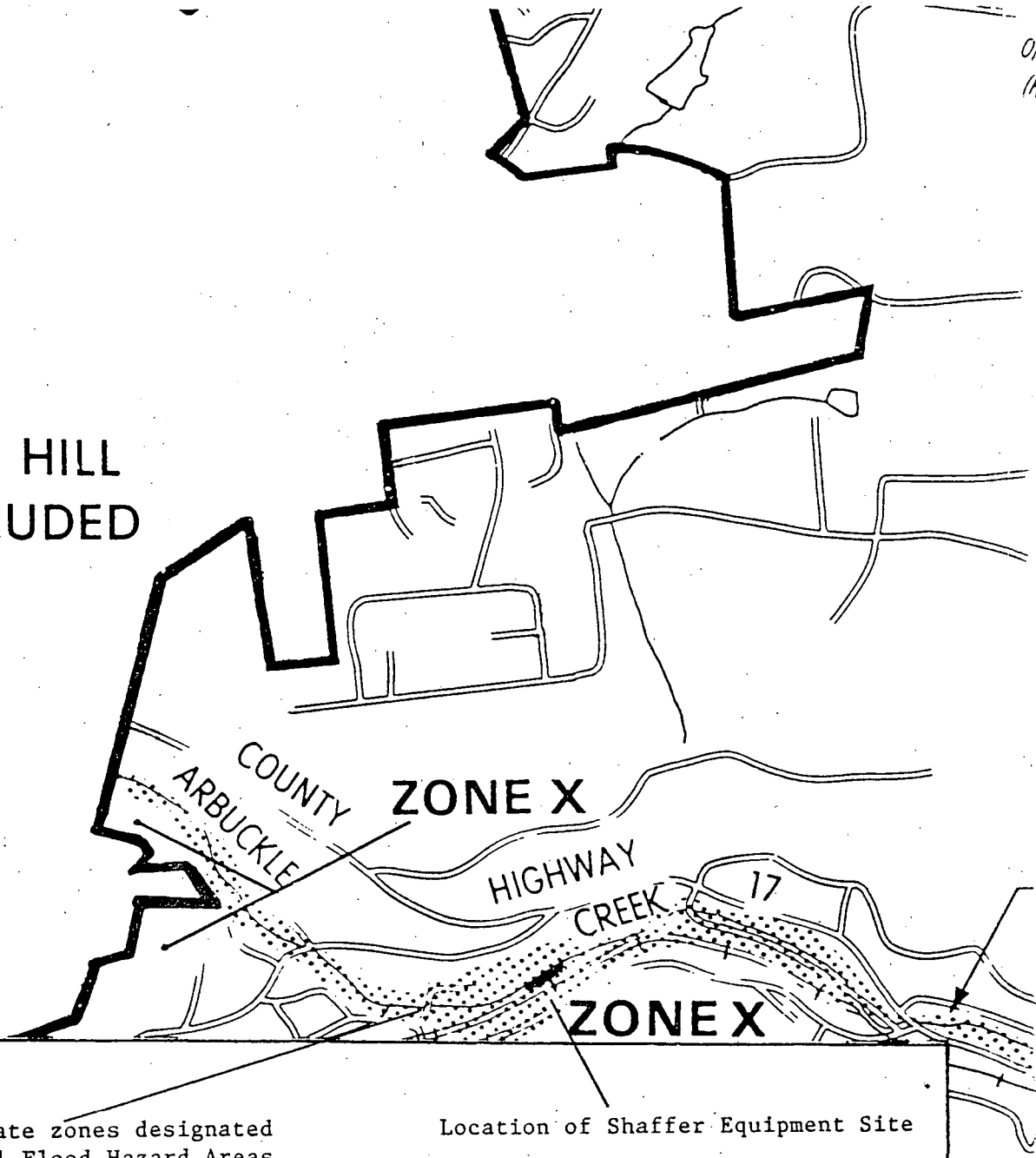
BOOKS/REPORTS

Wolf, Paul R. 1983. *Elements of Photogrammetry*. McGraw-Hill Book Company, New York.

Bausch & Lomb, Instruction Manual for Model ZT4-H Zoom Transfer Scope. Bausch & Lomb, Rochester, New York.

ORIGINAL
(Red)

TY OF OAK HILL
EA NOT INCLUDED



Shaded Areas indicate zones designated
by FEMA as "Special Flood Hazard Areas
Inundated By 100-Year Flood."

Location of Shaffer Equipment Site

Figure 4. Source: Flood Insurance Rate Map, Fayette County, West Virginia,
Unincorporated Areas. Community Panel Number 540026 0175 B,
Dated March 4, 1988. Federal Emergency Management Agency.